IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Roger Proksch et al Art Unit: 2862
Serial No: 10/016,475 Examiner: Jay M. Patidar
Filed : April 12, 2006
TITLE: Linear variable differential transformers for high precision position measurements

BRIEF ON APPEAL (Replacement)

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice dated October 31, 2007, Applicant herewith re-files the Appeal Brief as originally filed on July 6, 2006.

The sections required by 37 CFR 41.37 follow:

(1) Real Party in Interest

The application is assigned to Asylum Research Corporation, who is hence the real party in interest.

(2) Related Appeals and Interferences

There are no known related appeals and/or interferences.

(3) Status of Claims

Claims 1-3 and 62-69 are pending in the case and are appealed via this appeal brief. The claims 4-61 have been

canceled during prosecution.

(4) Status of Amendments

An amendment after final was filed on February 6, 2006. An advisory action dated March 1, 2006 refused to enter this amendment.

(5) Summary of Claimed Subject Matter

Claim 1 defines a displacement transducer with first and second non-ferromagnetic coil forms having a common axis, and each having at least one winding. This is shown in figure 2, and explained on page 8 in the full paragraph bridging over to page 9. The diameter relationships of the forms are described page 8, third through fifth lines of the last paragraph.

The windings are magnetically coupled to one another and the coil forms are made of non-ferromagnetic material. See page 8, lines 5-8. The RMS noise represents less than 2.1 nm of movement between the coils. See page 13, second paragraph, the last line.

Claim 64 requires first and second non-ferromagnetic coil forms, formed of non-ferromagnetic material with a common axis, see figure 2, page 8 and 9. The coils are one inside the other, see the paragraph bridging pages 8 and 9. The coils are

magnetically coupled to one another, See the paragraph bridging pages 8-9.

Claim 67 further requires first and second non-ferromagnetic coil forms with a common axis, which are explained and shown figure 2, pages 8 and 9. The two coils; one inside the other are also described in the paragraph bridging pages 8 and 9. The forms include "means for reducing Barkhausen noise". See, generally, page 11 of the specification, top paragraph.

Claim 69 requires forming first and second magnetic coil forms (see the paragraph bridging pages 8 and 9), allowing the coil forms to move relative to each other (again, see the paragraph bridging pages 8 and 9), reducing the effect of Barkhausen noise as they move (page 11, top paragraph) and generating an output signal responsive to relative displacements, where the output signal has an RMS noise with a positional accuracy of 2.1 nm or less. See page 13, second paragraph, last line.

(6) Grounds of Rejection

The ground of rejection to be reviewed on appeal is whether Claims 1-3 and 62-69 properly rejected as being unpatentable under 35 USC 103 as being unpatentable over Neff in view of the alleged admitted prior art and in view of common knowledge in

the art.

(7) Argument

To reiterate the above, claims 1-3 and 62-69 are rejected under 35 USC 103{a) as allegedly being unpatentable over Neff in view of the alleged admitted prior art and in view of the alleged common knowledge in the art. This contention is respectfully traversed.

First, the admitted prior art simply admits that the prior art described attempted to reduce Barkhausen and electrical noise in conventional LVDTs. It was never said that non-ferromagnetic or magnetic coil forms were well-known in the art. In fact, this statement is strongly disagreed with. Applicants have previously requested a reference in support of this feature to the extent that the rejection was based on personal knowledge of the Examiner. No such reference has been provided.

The office action states that it is "very common in the magnetic field to have u coil form made from non-ferromagnetic material e.g. plastic bobbins". However, this is entirely based on speculation. The question is whether it is obvious to modify a displacement transducer of the claimed type to use a non-ferromagnetic material. No reference has been cited to show this, and no proper showing of this has been made. Accordingly,

on its face, the rejection does not meet the patent office's burden of providing a prima facie showing of unpatentability. Turning more specifically to the actual rejection, Claim 1 defines a displacement transducer where the coil forms can be displaced relative to each other, where at least one winding on the magnetic movable coil form is magnetically coupled to the other, and has electronic circuitry "generating a signal responsive to relative displacements between the coil forms in the range of microns or less and having an RMS noise representing less than 2.1 nm of movement between the coils".

Note the specific language of Clam 1 requires that there are first and second non-ferromagnetic coil forms. Since the specific structure, "forms" is claimed, the claimed combination must be claiming a material that actually makes the forms. A so-called air core is not a form, in fact, an air core has no structure at all -- it is a lack of a form.

With all due respect, Neff is much less sensitive than the displacement sensor that is claimed by the numerical range of Claim 1. Neff describes a number of configurations of the LVDT primary and LVDT secondary coils. One of those coils has its primary wound on an air core. Neff refers to the electronics that are required to complete a functioning LVDT using the following language:

"*Also in each modification [of the LVDT coils] the wiring diagram including leads from the coils to a circuit including a vacuum tube oscillator and electronic volt meter circuit are similar to each other and generally similar to that shown in the US patent to Joseph J. Neff for electrical caliper, number 2,364,237 dated December 5, 1944*"

See column 2 of the Neff patent, lines 23-29.

Hence, the sensitivity of the electronics must be that as considered in the earlier US patent 2,364,237. Neff '237 characterizes the sensitivity by stating

"*the voltmeter is so designed that its sensitivity may be adjusted depending on the precision desired in the measurement of work. The pickup mechanism is capable of accurate measurements in the orders of tenths of thousands of an inch*"

Neff '237, column 2, lines 10-15.

1/10,000th of an inch is 2.54μ. Claim 1 defines an apparatus that has "electronic circuitry generating a signal responsive to relative displacements between the coil forms in the range of microns or less". Hence, the apparatus is more sensitive than that described in Neff.

In addition, Claim 1 defines that the RMS noise represents

less than 2.1 nm of movement between the coils. Since Neff's measurements are only accurate to the order of tenths of thousandths of an inch, this is clearly orders of magnitude qreater than the claimed 2.1 nm of movement". Neff is much less accurate than the claimed range.

Moreover, nothing in the hypothetical combination of prior art would suggest, or in any way reasonably lead to techniques of this accuracy improvement. Nothing in the prior art suggests that this kind of accuracy improvement could be obtained by using a coil form that does not have ferromagnetic materials therein, as claimed. Nothing in the prior art has ever even suggested that such a coil form would even be necessary or desirable.

Moreover, consider the so-called KSR factors, set forth in Federal Register volume 72 number 195. None of these factors would be a proper basis for rendering obvious the currently rejected claims.

Rationale A is combining prior art elements according to known methods to yield predictable results. As described above, there are nothing predictable about the results obtained herein. The issue of noise caused by these materials was not known prior to the disclosure in this application. In any case, even if the prior art is combined as suggested by the official action,

nothing in this hypothetical combination of prior art suggests structural yet non ferromagnetic coil form as claimed.

Rationale B is substitution of one known element for another to obtain predictable results. Here, there is nothing predictable about the results, and in any case no substitution could possibly lead to these results.

Rationale C is use of knowing techniques to improve similar devices in the same way. There is nothing in the prior art that suggests the claimed specific way of improving the operation of the device: quite simply this is a new way of improving the device not suggested or disclosed by the cited prior art.

Rationale D is applying a known technique to a known device to yield predictable results. The improvement here is not predictable: the source of the problem (reduction of Barkhausen noise to improve resolution), in fact, was not known before the disclosure thereof by the applicant.

Rationale E - obvious to try - is inapplicable since there are not here a finite number of identified predictable solutions.

Rationale F is known work in one field being applicable to another field. Here, there is a new problem, not suggested by the prior art, and no showing that any problem in any other

field could be applied to this field.

Rationale G is the teaching, suggestion, or motivation test. Here, there is no teaching, suggestion or motivation of this system in the prior art.

For all of these reasons, it should be seen that the present system is wholly unobvious based on the cited prior art.

Finally, while the admitted prior art does describe the advantages of removing Barkhausen noise, it also describes that the known schemes for removing that noise are ineffective: increasing the primary drive current, and others described in the specification on page 5; The specification also describes that some LVDT designs may have eliminated that noise without understanding that they were doing, by "substituting an air core for the ferromagnetic core of the conventional LVDT. Clearly substituting the air core, as may have been done in Neff, does not make it obvious to do this in order to form an RMS noise representing less than 2.1. nm of movement between the coils as claimed .

Therefore, Claim 1 should be allowable for these reasons.

Claim 62 defines that the first and second coil forms collectively form means for reducing Barkhausen noise ... ". According to the patent office's examination regulations, this

claim can only be found obvious if the prior art "performs the function specfied in the claims" (MPEP 2183). Therefore, a proper rejection of this claim must show that the reference actually reduces the Barkhausen noise. Nothing in the cited prior art teaches or suggests this feature.

The remaining claims should be allowable for similar reaaons, Claim 64 requires the coil forms made of non-ferromagnetic material. Neff teaches an air core. An air core is not a core made of "non-ferromagnetic material coil form". In fact, the air core is not a coil form at all. Therefore, this does not render obvious Claim 64.

Claims 65 and 66 should be allowable for analogous reasons. Claim 61 defines that the coil forms are "means for reducinq Barkhausen noise". This is further patentable over the cited prior art which teaches nothing about using this specific structure to reduce the Barkhausen noise.

Finally, Claim 69 defines a method of operating a transducer which includes "reducing an effect of Barkhausen noise on the coil forms as they move". Nothinq in the cited prior art teaches or suggests this feature. The admitted prior art in fact teaches that the techniques disclosed therein do not actually do that.

Accordingly, and with all due respect, the rejection set

forth has quite clearly tailed to meet the patent office's burden of providing a prima facie showing of unpatentability. With all due respect, therefore, reversal of the leqally incorrect position taken by the patent office is respectfully requested.

All fees were previously paid. Please charge any fees due in connection with this response, to Deposit Account No. 50-4376, small entity.

Respectfully submitted,

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Appendix of Claims

1. A displacement transducer comprising: first and second non-ferromagnetic coil forms with a common axis, each of said first and second coil forms wound with at least one winding;

an outside diameter of the first form and said at least one winding being smaller than an inside diameter of the second form so that said first and second forms may be displaced relative to each other with the first form inside the second form, one of the coil forms being movable and the other coil form being stationary;

the at least one winding on the movable form magnetically coupled to the at least one winding on the stationary form in the absence of any ferromagnetic element inductively coupling the windings; and

electronic circuitry generating a signal responsive to relative displacements between the coil forms in the range of microns or less and having an RMS noise representing less than 2.1 nm of movement between the coils.

2. The transducer of claim 1, in which the sensor comprises the coil form with the smaller outside diameter wound with

two or more windings and the other coil form wound with a single winding.

3. The transducer of claim 1, in which the sensor comprises the coil form with the larger inside diameter wound with two or more windings and the outer coil form wound with a single winding.

62. A transducer as in claim 1, wherein said first coil form and said second core form collectively means for reducing Barkhausen noise in the displacement transducer.

63. A transducer as in claim 1, wherein said electronic circuitry generates a signal having an RMS noise which produces a positional inaccuracy of less than 1.9 nm.

64. A displacement transducer comprising:

first and second non-ferromagnetic coil forms made of non-ferromagnetic material with a common axis, each of said first and second coil forms wound with at least one winding;

an outside diameter of the first coil form and said at least one winding being smaller than an inside diameter of the second coil form 80 that said first and second coil forms may be

displaced relative to each other with the first coil form inside the second coil form, and with one of the coil forms being movable and the other coil form being stationary;

the at least one winding on the movable form magnetically coupled to the at least one winding on the stationary form in the absence of any ferromagnetic element inductively coupling the windings; and

electronic circuitry generating a signal responsive to relative displacements between the coil forms in the range of microns or less.

65. A transducer as in claim 64, wherein said electronic circuitry generates said signal having an RMS noise which produces a positional inaccuracy of less than 2.1 nm.

66. A transducer as in claim 64, wherein said coil forms and said core forms collectively means for reducing Barkhausen noise in the displacement transducer.

67. A displacement transducer comprising:

first and second non-ferromagnetic coil forms with a common axis, each of said first and second coil forms wound with at least one winding;

an outside diameter of the first coil form and its at least one winding being smaller than an inside diameter of the second coil form so that said first and second coil forms may be displaced relative to each other with the first coil form inside the second coil form, and with one of the coil forms being movable and the other coil form being stationary;

said first coil form and said second coil core forms including means for reducing Barkhausen noise when the first and second coil forms move relative to each other; and

electronic circuitry generating a signal responsive to relative displacements between the coil forms in the range of microns or less and having reduced Barkhausen noise effect.

68. A transducer as in claim 67, wherein said electronic circuitry generates said signal having an RMS noise which produces a positional inaccuracy of less than 2.1 nm.

69. A method of operating a displacement transducer, comprising:

forming first and second non-ferromagnetic coil forms which each have at least one winding, and are wound with a common axis, with one of coil forms being inside the other;

allowing one of said coil forms to move relative to the

other;

reducing an effect of Barkhausen noise on the coil forms as they move; and

generating an output signal responsive to relative displacements between the coil forms, which output signal has an RMS noise that forms a positional inaccuracy of 2.1 nm or less.

Related Proceedings Appendix: None

Evidence Appendix: None